Inhibitory Abilities Moderate the Relationship Between Nucleus Accumbens Reward Sensitivity and Measures of Wellbeing and Clinical Symptoms

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Introduction

- A goal of personality neuroscience has been to identify neural systems that underlie individual differences in emotion and behaviour.
- This research program has led to a paradoxical finding: **heightened reward sensitivity has been linked to both wellbeing and clinical symptoms of mania** and mania-risk (hypomania)[1-3].
- Though both wellbeing and mania/hypomania share a common substrate of reward sensitivity and approach motivation[4], they may be differentiated by the degree to which successful management of reward sensitivity can be accomplished.
- Reward sensitivity is necessary for goal-directed action. We need to experience stimuli as interesting and worth pursuing. With insufficient reward sensitivity, states like inaction and anhedonia can result.
- However, experiencing stimuli in our environment as worth pursuing also presents a problem, we need to be able to successfully inhibit the pursuit of some stimuli, namely those which are antithetical to our needs and goals.
- Given these previous findings, it is likely that neural systems underlying reward sensitivity need to be understood in the psychological context in which they operate. In this program of research, we investigate one such context – inhibitory control.
- Specifically, **we hypothesize that the better one's inhibitory control ability, the better one can channel interest into successful goal-directed action, leading to wellbeing. Yet, with less inhibitory control ability, the approach motivation which comes from high reward sensitivity is harder to manage, perhaps leading to negative psychological consequences.**
- To begin to answer this question, and to understand the moderated nature of neuroscience markers of well-being, we explored whether inhibitory ability moderated relationships between reward sensitivity and measures of wellbeing and hypomania in a large fMRI sample.

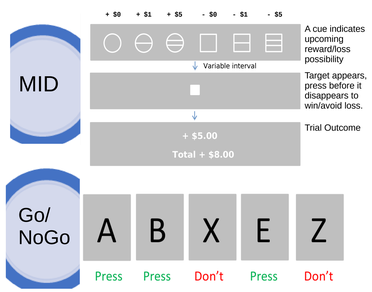
Methods

Participants & Questionnaires

N=250 — No previous neurological or clinical history

Scales — Subjective Happiness Scale (SHS); Hypomanic Personality Scale (HPS)

fMRI Tasks



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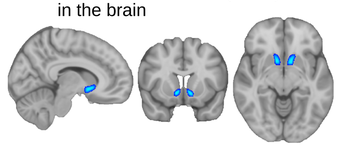
Neural Markers

Reward Sensitivity: The nucleus accumbens and the Monetary Incentive Delay task

The nucleus accumbens (NAcc) is critically involved in processing both how much you want something and how much you like something[5].

The Monetary Incentive Delay (MID) fMRI task's winning and losing of money on each trial induces NAcc activity that strongly changes based on how much participants want and like such events[6].

Nucleus Accumbens (NAcc) in the brain

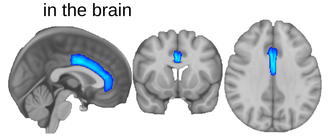


Inhibitory Ability: The anterior cingulate cortex and the Go/NoGo task

The anterior cingulate cortex (ACC) is a central component underlying inhibitory abilities and related executive functioning[7].

In the Go/NoGo task, "NoGo" trials require quickly inhibiting a habitual button-press response. Better inhibitory control should result in fewer NoGo errors. The ACC is highly active during this inhibition process[8].

Anterior Cingulate Cortex (ACC) in the brain



Results

Moderation by Go/NoGo Task Performance

- NAcc activity was predicted by a significant interaction between Hypomania (HPS) and individual differences in the number of Go/NoGo inhibition errors. Hypomania was a positive predictor of NAcc activity, but only in participants with the upper half of NoGo error rates (Figure 1.).
- NAcc activity was predicted by a significant interaction between wellbeing (SHS) and individual differences in the number of Go/NoGo inhibition errors. Wellbeing (SHS) was a positive predictor of NAcc activity, but only in participants with the lower half of NoGo error rates (Figure 2.).

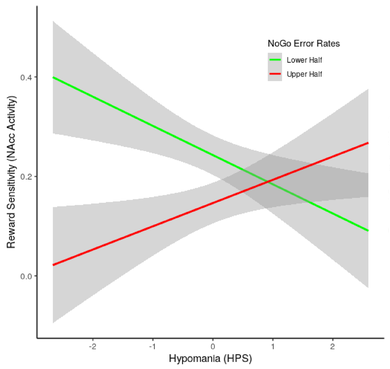


Figure 1.

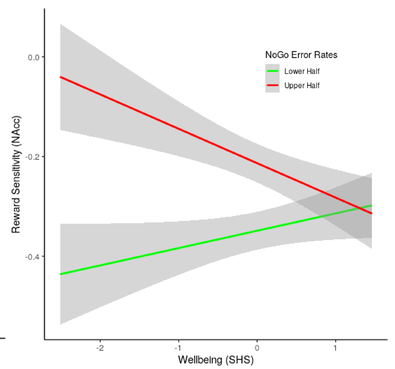


Figure 2.

Results (con't)

Moderation by Go/NoGo Inhibition fMRI signal

- NAcc activity was predicted by a significant interaction between Hypomania scores (HPS) and mean ACC signal strength during NoGo errors. Hypomania scores were a positive predictor of NAcc activity, but only in participants with the lower half of ACC signal strength (Figure 3.).
- NAcc activity was predicted by a significant interaction between wellbeing (SHS) and mean ACC signal strength during Go/NoGo task errors. Wellbeing was a positive predictor of NAcc activity, but only in participants with the upper half of ACC signal strength (Figure 4.).

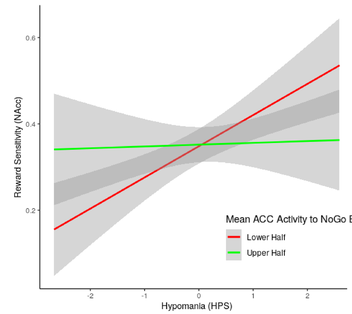


Figure 3.

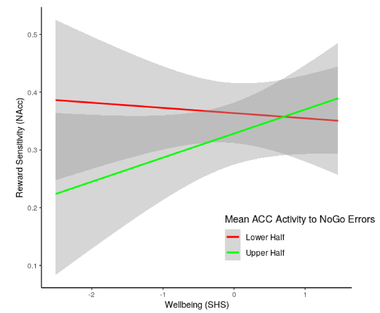


Figure 4.

Discussion

- Inhibitory abilities moderated the relationship that wellbeing and hypomania had with reward sensitivity, and this moderation existed using both a behavioural measure of inhibitory ability and a neural signature of inhibitory ability.
- **Hypomania was positively related to higher reward sensitivity, but only in those with poorer inhibitory abilities. Meanwhile, wellbeing was positively related to higher reward sensitivity, but only in those with greater inhibitory abilities.**
- The current works suggests that, in isolation, **reward sensitivity is neither a good or bad thing**. The neural systems underlying reward sensitivity need to be understood in the psychological context in which they operate, if they are to be effectively linked to wellbeing and clinical outcomes.
- Sometimes more reward sensitivity and associated approach motivation can be a bad thing. If the interplay between one's inhibitory abilities and reward sensitivity leans too heavily in favour of reward sensitivity, one may too often find themselves approaching and pursuing stimuli that are not in the best interest of one's longer-term goals.
- Sometimes less reward sensitivity and approach motivation can be a bad thing. If the interplay between inhibitory abilities and reward sensitivity leans too heavily in favour of inhibitory abilities, states of anhedonia, depression, and anxiety may result from an inability to enjoy and explore one's world.

References

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